UNLEASH THE POWER OF LIMITLESS CONNECTIVITY
Flexible MAC Architecture in the Cloud: Architectures for a virtual world

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Vecima
FMA: Does it Cloud?
Flexible MAC Architecture

CableLabs FMA Intro

DOCSIS MAC located flexibly in network
- First: Remote MACPHY (RMD)
- Later: Remote MAC Core (RMC)

3 main Components:
1. MAC Manager
2. PacketCable Aggregator
3. MAC-NE (RMD)

Under CableLabs DCA / DAA project
- “brother” to RPDs (MHAv2)
Management and Data plane separation

FMA: separates Management and Control plane functionality
- Management plane can be virtualized
- Data plane optimized in silicon

FMA: limits DOCSIS to RMD

MAC Manager uniquely suited to Cloud deployment
Cloud Operators

Different ways to deploy into the Cloud

MAC Manager does not do data plane processing, so focus on Agility

SaaS additions to MAC Managers can offer big benefits but some are often cloud-vendor specific reducing flexibility in cloud partner
Hybrid-Networks

Hybrid network connects Operator network to Cloud network

- Public Internet (Not recommended)
- VPN (over Internet)
  - Pro: Easy to get started
  - Con: Scaling issues
- Direct Connection
  - Pro: Fast, predictable latency
  - Con: Expensive, not software provision-able
- Extended Hosting
  - Pro: Even faster
  - Con: Reliant on Operator DC
Experiment Topology

Management Plane in Cloud
Data Plane (Customer traffic) “on-prem”

- Local Cloud Region
  - US Northeast
- Availability Zone
  - Unique networking and power
- VPC
  - A private network for compute
  - No internet access
## Traffic Types

1. **Steady State**
   - While the system is operational, this is all the steady state control and management plane data exchanged between MAC Manager and Nodes

2. **On Demand / Burst**
   - Traffic ‘Bursts’ triggered by user actions, such as downloading new software releases

<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemetry</td>
<td>Steady State</td>
<td>Ongoing streaming of metrics and statistics used to monitor operation and fulfill SNMP, CLI, Alarms, etc</td>
</tr>
<tr>
<td>IPDR</td>
<td>Steady State</td>
<td>Regular streaming of metrics to fulfill IPDR records</td>
</tr>
<tr>
<td>Support Info</td>
<td>Steady State</td>
<td>Gathering of debug counters, history, and status information</td>
</tr>
<tr>
<td>Logs</td>
<td>Steady State</td>
<td>Ongoing streaming of log messages</td>
</tr>
<tr>
<td>Heartbeats</td>
<td>Steady State</td>
<td>Ongoing Heartbeat and Keep-alive traffic</td>
</tr>
<tr>
<td>Firmware Upgrade</td>
<td>On Demand</td>
<td>Triggered downloads of new Node firmware</td>
</tr>
<tr>
<td>CLI</td>
<td>On Demand</td>
<td>SSH connections directly to the Nodes</td>
</tr>
</tbody>
</table>
Consumption

- Variable bandwidth consumption
  - Implementation dependent
  - Services deployed
  - Configured reporting, if applicable

- Steady-State: mostly Upstream
- On-Demand: mostly Downstream

- Our experiment used:
  - 6-10 Mb/s per RMD Steady-State

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Size</th>
<th>Downstream Bandwidth</th>
<th>Upstream Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemetry</td>
<td>Constant</td>
<td></td>
<td>4.3 Mb/s</td>
</tr>
<tr>
<td>IPDR</td>
<td>Constant</td>
<td></td>
<td>1.0 Mb/s</td>
</tr>
<tr>
<td>Support Info</td>
<td>~ 30MB</td>
<td></td>
<td>76 Mb/s</td>
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<tr>
<td>Configuration</td>
<td>n/a</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Logs</td>
<td>Constant</td>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>Heartbeats</td>
<td>Constant</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Firmware Upgrade</td>
<td>~ 131MB</td>
<td>116 Mb/s</td>
<td></td>
</tr>
<tr>
<td>SSH/CLI</td>
<td>n/a</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
</tbody>
</table>
Latency into the Cloud

Can be highly variable...

- MAC Managers Regionally deployed to RMDs
- Establish Hybrid-Cloud connections
- Monitor RMD <-> MAC Manager latency

<table>
<thead>
<tr>
<th>Zone (US Southeast to...)</th>
<th>Average RTT (ms)</th>
<th>Std Dev (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Northeast</td>
<td>30.37</td>
<td>9.16</td>
</tr>
<tr>
<td>US Central</td>
<td>64.79</td>
<td>13.52</td>
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<tr>
<td>US Northwest</td>
<td>85.99</td>
<td>17.43</td>
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<tr>
<td>US Southwest</td>
<td>79.26</td>
<td>14.82</td>
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<tr>
<td>Europe (Frankfurt)</td>
<td>132.08</td>
<td>17.31</td>
</tr>
<tr>
<td>Asia (Tokyo)</td>
<td>254.31</td>
<td>26.26</td>
</tr>
</tbody>
</table>
Latency Results

Latency to the Cloud provider
- Affects Management traffic
- Does not affect customer traffic
- Does not add to customer latency

Tested a range of latencies
- No operational faults in higher latencies
- Some operations, particularly big On-Demand workloads, were slower but successful
Conclusion

FMA Management/Data Plane separation uniquely suited for Cloud deployment

FMA MAC Manager absolutely works in Cloud environments

Cloud providers can provide “instant on” compute and services availability

Increased agility, flexibility, and software-defined services
Thank You!

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